

SEQUENCE LISTING

<110> Hanke, Paul D.
 Li D'Elia, Lhing Yew
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 Crafton, Corey
 Walsh, Holly

<120> Increased Lysine Production by Gene Amplification

<130> 1533.1030002

<140> 09/722,441
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<150> US 60/173,707
 <151> 1999-12-30

<150> US 60/184,130
 <151> 2000-02-22

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<170> PatentIn version 3.0

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Asn Val Leu Tyr Asp Asp Gln Val Gly Lys Val Ser Leu Val Gly Ala
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Gly Met Lys Ser His Pro Gly Val Thr Ala Glu Phe Met Glu Ala Leu
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Phe	Phe	Ala	Ser	Pro	Arg	Ser	Ala	Gly	Arg	Lys	Ile	Glu	Phe	Arg	Gly	
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Thr	Glu	Ile	Glu	Val	Glu	Asp	Ile	Thr	Gln	Ala	Thr	Glu	Glu	Ser	Leu	
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Gln	Tyr	Ala	Pro	Leu	Phe	Ala	Ala	Ala	Gly	Ala	Thr	Val	Val	Asp	Asn	
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Lys Gly Ile Asp Val Ala Leu Phe Ser Ala Gly Gly Thr Ala Ser Lys
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Gln Tyr Ala Pro Leu Phe Ala Ala Ala Gly Ala Thr Val Val Asp Asn
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<213> Corynebacterium glutamicum

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Gly Gly Val Ser Leu Ala Lys Ala Ala Leu Arg Leu Gln Gly Ile Asn
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Glu Val Val Val Asp Phe Thr Thr Pro Asn Ala Val Met Gly Asn Leu
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gag ttc tgc atc aac aac ggc att tct gcg gtt gtt gga acc acg ggc 240
Glu Phe Cys Ile Asn Asn Gly Ile Ser Ala Val Val Gly Thr Thr Gly
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<213> *Corynebacterium glutamicum*

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 100 105 110

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 115 120 125

Glu Val Ile Glu Leu His His Pro Asn Lys Leu Asp Ala Pro Ser Gly
 130 135 140

Thr Ala Ile His Thr Ala Gln Gly Ile Ala Ala Ala Arg Lys Glu Ala
 145 150 155 160

Gly Met Asp Ala Gln Pro Asp Ala Thr Glu Gln Ala Leu Glu Gly Ser

165

170

175

Arg Gly Ala Ser Val Asp Gly Ile Pro Val His Ala Val Arg Met Ser
180 185 190

Gly Met Val Ala His Glu Gln Val Ile Phe Gly Thr Gln Gly Gln Thr
195 200 205

Leu Thr Ile Lys Gln Asp Ser Tyr Asp Arg Asn Ser Phe Ala Pro Gly
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Val Leu Val Gly Val Arg Asn Ile Ala Gln His Pro Gly Leu Val Val
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Gly Leu Glu His Tyr Leu Gly Leu
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<213> *Corynebacterium glutamicum*

<220>

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<222> (1)..(1023)

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gat tac aag aac atg acc aac atc cgc gta gct atc gta ggc tac gga 96
Asp Tyr Lys Asn Met Thr Asn Ile Arg Val Ala Ile Val Gly Tyr Gly
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aac ctg gga cgc agc gtc gaa aag ctt att gcc aag cag ccc gac atg 144
Asn Leu Gly Arg Ser Val Glu Lys Leu Ile Ala Lys Gln Pro Asp Met
35 40 45

gac ctt gta gga atc ttc tcg cgc cgg gcc acc ctc gac aca aag acg 192
Asp Leu Val Gly Ile Phe Ser Arg Arg Ala Thr Leu Asp Thr Lys Thr
50 55 60

cca gtc ttt gat gtc gcc gac gtg gac aag cac gcc gac gac gtg gac 240
Pro Val Phe Asp Val Ala Asp Val Asp Lys His Ala Asp Asp Val Asp
65 70 75 80

gtg ctg ttc ctg tgc atg ggc tcc gcc acc gac atc cct gag cag gca 288
Page 14

Val	Leu	Phe	Leu	Cys	Met	Gly	Ser	Ala	Thr	Asp	Ile	Pro	Glu	Gln	Ala		
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Pro	Lys	Phe	Ala	Gln	Phe	Ala	Cys	Thr	Val	Asp	Thr	Tyr	Asp	Asn	His		
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Arg	Asp	Ile	Pro	Arg	His	Arg	Gln	Val	Met	Asn	Glu	Ala	Ala	Thr	Ala		
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Glu	Val	Ala	Pro	Tyr	Leu	Leu	Ser	Pro	Glu	Asn	Leu	Asp	Asp	Leu	Ile		
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1023

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<213> *Corynebacterium glutamicum*

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35 40 45

Asp Leu Val Gly Ile Phe Ser Arg Arg Ala Thr Leu Asp Thr Lys Thr
50 55 60

Pro Val Phe Asp Val Ala Asp Val Asp Lys His Ala Asp Asp Val Asp
65 70 75 80

Val Leu Phe Leu Cys Met Gly Ser Ala Thr Asp Ile Pro Glu Gln Ala
85 90 95

Pro Lys Phe Ala Gln Phe Ala Cys Thr Val Asp Thr Tyr Asp Asn His
100 105 110

Arg Asp Ile Pro Arg His Arg Gln Val Met Asn Glu Ala Ala Thr Ala
115 120 125

Ala Gly Asn Val Ala Leu Val Ser Thr Gly Trp Asp Pro Gly Met Phe
130 135 140

Ser Ile Asn Arg Val Tyr Ala Ala Ala Val Leu Ala Glu His Gln Gln
145 150 155 160

His Thr Phe Trp Gly Pro Gly Leu Ser Gln Gly His Ser Asp Ala Leu
165 170 175

Arg Arg Ile Pro Gly Val Gln Lys Ala Val Gln Tyr Thr Leu Pro Ser
180 185 190

Glu Glu Ala Leu Glu Lys Ala Arg Arg Gly Glu Ala Gly Asp Leu Thr
 195 200 205
 Gly Lys Gln Thr His Lys Arg Gln Cys Phe Val Val Ala Asp Ala Ala
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 Asp His Glu Arg Ile Glu Asn Asp Ile Arg Thr Met Pro Asp Tyr Phe
 225 230 235 240
 Val Gly Tyr Glu Val Glu Val Asn Phe Ile Asp Glu Ala Thr Leu Asp
 245 250 255
 Ala Glu His Thr Gly Met Pro His Gly Gly His Val Ile Thr Thr Gly
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 Asp Thr Gly Gly Phe Asn His Thr Val Glu Tyr Ile Leu Lys Leu Asp
 275 280 285
 Arg Asn Pro Asp Phe Thr Ala Ser Ser Gln Ile Ala Phe Gly Arg Ala
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 Ala His Arg Met Lys Gln Gln Gly Gln Ser Gly Ala Phe Thr Val Leu
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cct	ctg	cct	gac	ctc	gct	gaa	gaa	tac	gga	acc	cca	ctg	ttc	gta	gtc	144
Pro	Leu	Pro	Asp	Leu	Ala	Glu	Glu	Tyr	Gly	Thr	Pro	Leu	Phe	Val	Val	
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Asp	Glu	Asp	Asp	Phe	Arg	Ser	Arg	Cys	Arg	Asp	Met	Ala	Thr	Ala	Phe	
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Gly	Gly	Pro	Gly	Asn	Val	His	Tyr	Ala	Ser	Lys	Ala	Phe	Leu	Thr	Lys	
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Thr	Ile	Ala	Arg	Trp	Val	Asp	Glu	Glu	Gly	Leu	Ala	Leu	Asp	Ile	Ala	
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Leu	Val	Gln	Asn	Gly	Val	Gly	His	Val	Val	Leu	Asp	Ser	Ala	Gln	Glu	
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Leu	Glu	Leu	Leu	Asp	Tyr	Val	Ala	Ala	Gly	Glu	Gly	Lys	Ile	Gln	Asp	
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gtg	ttg	atc	cgc	gtg	aag	cca	ggt	atc	gaa	gcc	cac	acc	cac	gag	ttc	528
Val	Leu	Ile	Arg	Val	Lys	Pro	Gly	Ile	Glu	Ala	His	Thr	His	Glu	Phe	
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Ile	Ala	Thr	Ser	His	Glu	Asp	Gln	Lys	Phe	Gly	Phe	Ser	Leu	Ala	Ser	
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Gly Tyr Gly Ile Ala Tyr Thr Ala Asp Glu Glu Pro Leu Asn Val Ala	
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Glu Val Ala Ser Asp Leu Leu Thr Ala Val Gly Lys Met Ala Ala Glu	
275 280 285	
cta ggc atc gac gca cca acc gtg ctt gtt gag ccc ggc cgc gct atc	912
Leu Gly Ile Asp Ala Pro Thr Val Leu Val Glu Pro Gly Arg Ala Ile	
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gca ggc ccc tcc acc gtg acc atc tac gaa gtc ggc acc acc aaa aac	960
Ala Gly Pro Ser Thr Val Thr Ile Tyr Glu Val Gly Thr Thr Lys Asn	
305 310 315	
gtc cac gta gac gac gac aaa acc cgc cgc tac gta gcc gtc gac gga	1008
Val His Val Asp Asp Lys Thr Arg Arg Tyr Val Ala Val Asp Gly	
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Gly Met Ser Asp Asn Ile Arg Pro Ala Leu Tyr Gly Ser Glu Tyr Asp	
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gcc cgc gta gta tcc cgc ttc gcc gaa gga gac cca gta agc acc cgc	1104
Ala Arg Val Val Ser Arg Phe Ala Glu Gly Asp Pro Val Ser Thr Arg	
355 360 365	
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Ile Val Gly Ser His Cys Glu Ser Gly Asp Ile Leu Ile Asn Asp Glu	
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Ile Tyr Pro Ser Asp Ile Thr Ser Gly Asp Phe Leu Ala Leu Ala Ala	
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acc ggc gca tac tgc tac gcc atg agc tcc cgc tac aac gcc ttc aca	1248
Thr Gly Ala Tyr Cys Tyr Ala Met Ser Ser Arg Tyr Asn Ala Phe Thr	
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cgg ccc gcc gtc gtg tcc gtc cgc gct ggc agc tcc cgc ctc atg ctg	1296
Arg Pro Ala Val Val Ser Val Arg Ala Gly Ser Ser Arg Leu Met Leu	
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<213> Corynebacterium glutamicum

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 35 40 45
 Asp Glu Asp Asp Phe Arg Ser Arg Cys Arg Asp Met Ala Thr Ala Phe
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 Gly Gly Pro Gly Asn Val His Tyr Ala Ser Lys Ala Phe Leu Thr Lys
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 Thr Ile Ala Arg Trp Val Asp Glu Glu Gly Leu Ala Leu Asp Ile Ala
 85 90 95
 Ser Ile Asn Glu Leu Gly Ile Ala Leu Ala Ala Gly Phe Pro Ala Ser
 100 105 110
 Arg Ile Thr Ala His Gly Asn Asn Lys Gly Val Glu Phe Leu Arg Ala
 115 120 125
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 130 135 140
 Leu Glu Leu Leu Asp Tyr Val Ala Ala Gly Glu Gly Lys Ile Gln Asp
 145 150 155 160
 Val Leu Ile Arg Val Lys Pro Gly Ile Glu Ala His Thr His Glu Phe
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 Ile Ala Thr Ser His Glu Asp Gln Lys Phe Gly Phe Ser Leu Ala Ser
 180 185 190
 Gly Ser Ala Phe Glu Ala Ala Lys Ala Ala Asn Asn Ala Glu Asn Leu
 195 200 205
 Asn Leu Val Gly Leu His Cys His Val Gly Ser Gln Val Phe Asp Ala
 210 215 220
 Glu Gly Phe Lys Leu Ala Ala Glu Arg Val Leu Gly Leu Tyr Ser Gln
 225 230 235 240
 Ile His Ser Glu Leu Gly Val Ala Leu Pro Glu Leu Asp Leu Gly Gly
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 Gly Tyr Gly Ile Ala Tyr Thr Ala Asp Glu Glu Pro Leu Asn Val Ala
 260 265 270

Glu Val Ala Ser Asp Leu Leu Thr Ala Val Gly Lys Met Ala Ala Glu
 275 280 285
 Leu Gly Ile Asp Ala Pro Thr Val Leu Val Glu Pro Gly Arg Ala Ile
 290 295 300
 Ala Gly Pro Ser Thr Val Thr Ile Tyr Glu Val Gly Thr Thr Lys Asn
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 Val His Val Asp Asp Asp Lys Thr Arg Arg Tyr Val Ala Val Asp Gly
 325 330 335
 Gly Met Ser Asp Asn Ile Arg Pro Ala Leu Tyr Gly Ser Glu Tyr Asp
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 Ala Arg Val Val Ser Arg Phe Ala Glu Gly Asp Pro Val Ser Thr Arg
 355 360 365
 Ile Val Gly Ser His Cys Glu Ser Gly Asp Ile Leu Ile Asn Asp Glu
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 Ile Tyr Pro Ser Asp Ile Thr Ser Gly Asp Phe Leu Ala Leu Ala Ala
 385 390 395 400
 Thr Gly Ala Tyr Cys Tyr Ala Met Ser Ser Arg Tyr Asn Ala Phe Thr
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Arg Asn Ala Val Arg Gln Glu Asp Gly Val Val Thr Val Ala Gly Val
20 25 30

cct ctg cct gac ctc gct gaa gaa tac gga acc cca ctg ttc gta gtc 144
Pro Leu Pro Asp Leu Ala Glu Glu Tyr Gly Thr Pro Leu Phe Val Val
35 40 45

gac gag gac gat ttc cgt tcc cgc tgt cgc gac atg gct acc gca ttc 192
Asp Glu Asp Asp Phe Arg Ser Arg Cys Arg Asp Met Ala Thr Ala Phe
50 55 60

ggt gga cca gcc aat gtg cac tac gca tct aaa gcg ttc ctg acc aag 240
Gly Gly Pro Gly Asn Val His Tyr Ala Ser Lys Ala Phe Leu Thr Lys
65 70 75 80

acc att gca cgt tgg gtt gat gaa gag ggg ctg gca ctg gac att gca 288
Thr Ile Ala Arg Trp Val Asp Glu Glu Gly Leu Ala Leu Asp Ile Ala
85 90 95

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Ser Ile Asn Glu Leu Gly Ile Ala Leu Ala Ala Gly Phe Pro Ala Ser
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Arg Ile Thr Ala His Gly Asn Asn Lys Gly Val Glu Phe Leu Arg Ala
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130 135 140

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Leu Glu Leu Leu Asp Tyr Val Ala Ala Gly Glu Gly Lys Ile Gln Asp
145 150 155 160

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Val Leu Ile Arg Val Lys Pro Gly Ile Glu Ala His Thr His Glu Phe
165 170 175

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Ile Ala Thr Ser His Glu Asp Gln Lys Phe Gly Phe Ser Leu Ala Ser
180 185 190

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Gly Ser Ala Phe Glu Ala Ala Lys Ala Ala Asn Asn Ala Glu Asn Leu
195 200 205

aac ctg gtt gcc ctg cac tgc cac gtt ggt tcc cag gtg ttc gac gcc 672
Asn Leu Val Gly Leu His Cys His Val Gly Ser Leu Val Phe Asp Ala
210 215 220

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Glu Gly Phe Lys Leu Ala Ala Glu Arg Val Leu Gly Leu Tyr Ser Gln
225 230 235 240

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Ile His Ser Glu Leu Gly Val Ala Leu Pro Glu Leu Asp Leu Gly Gly
245 250 255 260

245	250	255	
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gaa gtt gcc tcc gac ctg ctc acc gca gtc gga aaa atg gca gcg gaa Glu Val Ala Ser Asp Leu Leu Thr Ala Val Gly Lys Met Ala Ala Glu 275 280 285			864
cta ggc atc gac gca cca acc gtg ctt gtt gag ccc ggc cgc gct atc Leu Gly Ile Asp Ala Pro Thr Val Leu Val Glu Pro Gly Arg Ala Ile 290 295 300			912
gca ggc ccc tcc acc gtg acc atc tac gaa gtc ggc acc acc aaa gac Ala Gly Pro Ser Thr Val Thr Ile Tyr Glu Val Gly Thr Thr Lys Asp 305 310 315 320			960
gtc cac gta gac gac gac aaa acc cgc cgt tac atc gcc gtg gac gga Val His Val Asp Asp Asp Lys Thr Arg Arg Tyr Ile Ala Val Asp Gly 325 330 335			1008
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<213> *Corynebacterium glutamicum*

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 35 40 45
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 50 55 60
 Gly Gly Pro Gly Asn Val His Tyr Ala Ser Lys Ala Phe Leu Thr Lys
 65 70 75 80
 Thr Ile Ala Arg Trp Val Asp Glu Glu Gly Leu Ala Leu Asp Ile Ala
 85 90 95
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 100 105 110
 Arg Ile Thr Ala His Gly Asn Asn Lys Gly Val Glu Phe Leu Arg Ala
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 130 135 140
 Leu Glu Leu Leu Asp Tyr Val Ala Ala Gly Glu Gly Lys Ile Gln Asp
 145 150 155 160
 Val Leu Ile Arg Val Lys Pro Gly Ile Glu Ala His Thr His Glu Phe
 165 170 175
 Ile Ala Thr Ser His Glu Asp Gln Lys Phe Gly Phe Ser Leu Ala Ser
 180 185 190
 Gly Ser Ala Phe Glu Ala Ala Lys Ala Ala Asn Asn Ala Glu Asn Leu
 195 200 205
 Asn Leu Val Gly Leu His Cys His Val Gly Ser Gln Val Phe Asp Ala
 210 215 220
 Glu Gly Phe Lys Leu Ala Ala Glu Arg Val Leu Gly Leu Tyr Ser Gln
 225 230 235 240
 Ile His Ser Glu Leu Gly Val Ala Leu Pro Glu Leu Asp Leu Gly Gly
 245 250 255

Gly Tyr Gly Ile Ala Tyr Thr Ala Ala Glu Glu Pro Leu Asn Val Ala
 260 265 270
 Glu Val Ala Ser Asp Leu Leu Thr Ala Val Gly Lys Met Ala Ala Glu
 275 280 285
 Leu Gly Ile Asp Ala Pro Thr Val Leu Val Glu Pro Gly Arg Ala Ile
 290 295 300
 Ala Gly Pro Ser Thr Val Thr Ile Tyr Glu Val Gly Thr Thr Lys Asp
 305 310 315 320
 Val His Val Asp Asp Asp Lys Thr Arg Arg Tyr Ile Ala Val Asp Gly
 325 330 335
 Gly Met Ser Asp Asn Ile Arg Pro Ala Leu Tyr Gly Ser Glu Tyr Asp
 340 345 350
 Ala Arg Val Val Ser Arg Phe Ala Glu Gly Asp Pro Val Ser Thr Arg
 355 360 365
 Ile Val Gly Ser His Cys Glu Ser Gly Asp Ile Leu Ile Asn Asp Glu
 370 375 380
 Ile Tyr Pro Ser Asp Ile Thr Ser Gly Asp Phe Leu Ala Leu Ala Ala
 385 390 395 400
 Thr Gly Ala Tyr Cys Tyr Ala Met Ser Ser Arg Tyr Asn Ala Phe Thr
 405 410 415
 Arg Pro Ala Val Val Ser Val Arg Ala Gly Ser Ser Arg Leu Met Leu
 420 425 430
 Arg Arg Glu Thr Leu Asp Asp Ile Leu Ser Leu Glu Ala
 435 440 445

<210> 15

<211> 753

<212> DNA

<213> *Corynebacterium glutamicum*

<220>

<221> CDS

<222> (1)..(753)

<400> 15
 gtg gcc gaa caa gtt aaa ttg agc gtg gag ttg ata gcg tgc agt tct 48
 Met Ala Glu Gln Val Lys Leu Ser Val Glu Leu Ile Ala Cys Ser Ser
 1 5 10 15

ttt act cca ccc gct gat gtt gag tgg tca act gat gtt gag gcc gcg 96
 Phe Thr Pro Pro Ala Asp Val Glu Trp Ser Thr Asp Val Glu Gly Ala
 20 25 30

gaa gca ctc gtc gag ttt gcg ggt cgt gcc tgc tac gaa act ttt gat 144
 Glu Ala Leu Val Glu Phe Ala Gly Arg Ala Cys Tyr Glu Thr Phe Asp
 35 40 45

aag ccg aac cct cga act gct tcc aat gct gcg tat ctg cgc cac atc 192
 Lys Pro Asn Pro Arg Thr Ala Ser Asn Ala Ala Tyr Leu Arg His Ile
 50 55 60

atg gaa gtg ggg cac act gct ttg ctt gag cat gcc aat gcc acg atg 240
 Met Glu Val Gly His Thr Ala Leu Leu Glu His Ala Asn Ala Thr Met
 65 70 75 80

tat atc cga gcc att tct cgg tcc gcg acc cat gaa ttg gtc cga cac 288
 Tyr Ile Arg Gly Ile Ser Arg Ser Ala Thr His Glu Leu Val Arg His
 85 90 95

cgc cat ttt tcc ttc tct caa ctg tct cag cgt ttc gtg cac agc gga 336
 Arg His Phe Ser Phe Ser Gln Leu Ser Gln Phe Val His Ser Gly
 100 105 110

gaa tcg gaa gta gtg gtg ccc act ctc atc gat gaa gat ccg cag ttg 384
 Glu Ser Glu Val Val Val Pro Thr Leu Ile Asp Glu Asp Pro Gln Leu
 115 120 125

cgt gaa ctt ttc atg cac gcc atg gat gag tct cgg ttc gct ttc aat 432
 Arg Glu Leu Phe Met His Ala Met Asp Glu Ser Arg Phe Ala Phe Asn
 130 135 140

gag ctg ctt aat gcg ctg gaa gaa aaa ctt gcc gat gaa ccg aat gca 480
 Glu Leu Leu Asn Ala Leu Glu Glu Lys Leu Gly Asp Glu Pro Asn Ala
 145 150 155 160

ctt tta agg aaa aag cag gct cgt caa gca gct cgc gct gtg ctg ccc 528
 Leu Leu Arg Lys Lys Gln Ala Arg Gln Ala Arg Ala Val Leu Pro
 165 170 175

aac gct aca gag tcc aga atc gtg gtg tct gga aac ttc cgc acc tgg 576
 Asn Ala Thr Glu Ser Arg Ile Val Val Ser Gly Asn Phe Arg Thr Trp
 180 185 190

agg cat ttc att gcc atg cga gcc agt gaa cat gca gac gtc gaa atc 624
 Arg His Phe Ile Gly Met Arg Ala Ser Glu His Ala Asp Val Glu Ile
 195 200 205

cgc gaa gta gcg gta gga tgt tta aga aag ctg cag gta gca gcg cca 672
 Arg Glu Val Ala Val Gly Cys Leu Arg Lys Leu Gln Val Ala Ala Pro
 210 215 220

act gtt ttc ggt gat ttt gag att gaa act ttg gca gac gga tcg caa 720
 Thr Val Phe Gly Asp Phe Glu Ile Glu Thr Leu Ala Asp Gly Ser Gln
 225 230 235

225 230 235 240
 atg gca aca agc ccg tat gtc atg gac ttt taa
 Met Ala Thr Ser Pro Tyr Val Met Asp Phe
 245 250

753

<210> 16
 <211> 250
 <212> PRT
 <213> *Corynebacterium glutamicum*

<400> 16
 Met Ala Glu Gln Val Lys Leu Ser Val Glu Leu Ile Ala Cys Ser Ser
 1 5 10 15
 Phe Thr Pro Pro Ala Asp Val Glu Trp Ser Thr Asp Val Glu Gly Ala
 20 25 30
 Glu Ala Leu Val Glu Phe Ala Gly Arg Ala Cys Tyr Glu Thr Phe Asp
 35 40 45
 Lys Pro Asn Pro Arg Thr Ala Ser Asn Ala Ala Tyr Leu Arg His Ile
 50 55 60
 Met Glu Val Gly His Thr Ala Leu Leu Glu His Ala Asn Ala Thr Met
 65 70 75 80
 Tyr Ile Arg Gly Ile Ser Arg Ser Ala Thr His Glu Leu Val Arg His
 85 90 95
 Arg His Phe Ser Phe Ser Gln Leu Ser Gln Arg Phe Val His Ser Gly
 100 105 110
 Glu Ser Glu Val Val Val Pro Thr Leu Ile Asp Glu Asp Pro Gln Leu
 115 120 125
 Arg Glu Leu Phe Met His Ala Met Asp Glu Ser Arg Phe Ala Phe Asn
 130 135 140
 Glu Leu Leu Asn Ala Leu Glu Glu Lys Leu Gly Asp Glu Pro Asn Ala
 145 150 155 160
 Leu Leu Arg Lys Lys Gln Ala Arg Gln Ala Ala Arg Ala Val Leu Pro
 165 170 175

Asn Ala Thr Glu Ser Arg Ile Val Val Ser Gly Asn Phe Arg Thr Trp
180 185 190

Arg His Phe Ile Gly Met Arg Ala Ser Glu His Ala Asp Val Glu Ile
195 200 205

Arg Glu Val Ala Val Gly Cys Leu Arg Lys Leu Gln Val Ala Ala Pro
210 215 220

Thr Val Phe Gly Asp Phe Glu Ile Glu Thr Leu Ala Asp Gly Ser Gln
225 230 235 240

Met Ala Thr Ser Pro Tyr Val Met Asp Phe
245 250

<210> 17

<211> 551

<212> DNA

<213> *Corynebacterium glutamicum*

<400> 17
aaccggtgtg gagccgacca ttccgcgagg ctgcactgca acgaggtcgt agttttggtg 60
catggcttct ggccagttca tggattggct gccgaagaag ctataggcat cgccaccagg 120
gccaccggag ttaccgaaga tggcgccgtg cttttcgctt tgggcaggga ccttgacaaa 180
gccacgcgtg atatcgccaa gtgagggatc agaatatgtc atgggcacgt cgatgctgcc 240
acattgagcg gaggcaatat ctacctgagg tgggcattct tccagcggga tgttttcttg 300
cgctgtgtgca gtgggcattg ataccaaaaa ggggctaagc gcagtcgagg cggaagaac 360
tgctactacc ttttttattg tcgaacgggg cattacggct ccaaggacgt ttgttttctg 420
ggtcagttac cccaaaaaag atatacagag accaatgatt ttctattaaa aaggcaggga 480
tttgtataaa gtatgggtcg tattctgtgc gacgggtgta cctcggctag aatttctccc 540
catgacacca g 551

<210> 18

<211> 365

<212> DNA

<213> *Corynebacterium glutamicum*

<220>

<221> CDS

<222> (1)..(365)

<400> 18

gtg gcc gaa caa gtt aaa ttg agc gtg gag ttg ata gcg tgc agt tct 48
Met Ala Glu Gln Val Lys Leu Ser Val Glu Leu Ile Ala Cys Ser Ser
1 5 10 15

ttt act cca ccc gct gat gtt gag tgg tca act gat gtt gag ggc gcg 96
Phe Thr Pro Pro Ala Asp Val Glu Trp Ser Thr Asp Val Glu Gly Ala
20 25 30

gaa gca ctc gtc gag ttt gcg ggt cgt gcc tgc tac gaa act ttt gat 144
Glu Ala Leu Val Glu Phe Ala Gly Arg Ala Cys Tyr Glu Thr Phe Asp
35 40 45

aag ccg aac cct cga act gct tcc aat gct gcg tat ctg cgc cac atc 192
Lys Pro Asn Pro Arg Thr Ala Ser Asn Ala Ala Tyr Leu Arg His Ile
50 55 60

atg gaa gtg ggg cac act gct ttg ctt gag cat gcc aat gcc acg atg 240
Met Glu Val Gly His Thr Ala Leu Leu Glu His Ala Asn Ala Thr Met
65 70 75

tat atc cga gcc att tct cgg tcc gcg acc cat gaa ttg gtc cga cac 288
Tyr Ile Arg Gly Ile Ser Arg Ser Ala Thr His Glu Leu Val Arg His
85 90 95

cgc cat ttt tcc ttc tct caa ctg tct cag cgt ttc gtg cac agc gga 336
Arg His Phe Ser Phe Ser Gln Leu Ser Gln Arg Phe Val His Ser Gly
100 105 110

gaa tcg gaa gta gtg gtg ccc act ctc at 365
Glu Ser Glu Val Val Val Pro Thr Leu
115 120

<210> 19

<211> 122

<212> PRT

<213> Corynebacterium glutamicum

<400> 19

Met Ala Glu Gln Val Lys Leu Ser Val Glu Leu Ile Ala Cys Ser Ser
1 5 10 15

Phe Thr Pro Pro Ala Asp Val Glu Trp Ser Thr Asp Val Glu Gly Ala
20 25 30

Glu Ala Leu Val Glu Phe Ala Gly Arg Ala Cys Tyr Glu Thr Phe Asp
35 40 45

Lys Pro Asn Pro Arg Thr Ala Ser Asn Ala Ala Tyr Leu Arg His Ile
 50 55 60

Met Glu Val Gly His Thr Ala Leu Leu Glu His Ala Asn Ala Thr Met
 65 70 75 80

Tyr Ile Arg Gly Ile Ser Arg Ser Ala Thr His Glu Leu Val Arg His
 85 90 95

Arg His Phe Ser Phe Ser Gln Leu Ser Gln Arg Phe Val His Ser Gly
 100 105 110

Glu Ser Glu Val Val Val Pro Thr Leu Ile
 115 120

<210> 20

<211> 833

<212> DNA

<213> *Corynebacterium glutamicum*

<220>

<221> CDS

<222> (1)..(833)

<400> 20
 atg gct aca gtt gaa aat ttc aat gaa ctt ccc gca cac gta tgg cca 48
 Met Ala Thr Val Glu Asn Phe Asn Glu Leu Pro Ala His Val Trp Pro
 1 5 10 15

cgc aat gca gtg cgc caa gaa gac ggc gtt gtc acc gtc gct ggt gtg 96
 Arg Asn Ala Val Arg Gln Glu Asp Gly Val Val Thr Val Ala Gly Val
 20 25 30

cct ctg cct gac ctc gct gaa gaa tac gga acc cca ctg ttc gta gtc 144
 Pro Leu Pro Asp Leu Ala Glu Glu Tyr Gly Thr Pro Leu Phe Val Val
 35 40 45

gac gag gac gat ttc cgt tcc cgc tgt cgc gac atg gct acc gca ttc 192
 Asp Glu Asp Asp Phe Arg Ser Arg Cys Arg Asp Met Ala Thr Ala Phe
 50 55 60

ggt gga cca ggc aat gtg cac tac gca tcc aaa gcg ttc ctg acc aag 240
 Gly Gly Pro Gly Asn Val His Tyr Ala Ser Lys Ala Phe Leu Thr Lys
 65 70 75 80

acc att gca cgt tgg gtt gat gaa gag ggg ctg gca ctg gac att gcg 288
 Thr Ile Ala Arg Trp Val Asp Glu Glu Gly Leu Ala Leu Asp Ile Ala
 85 90 95

tcc atc aat gaa ctg ggc att gcc ctg gcc gct ggt ttc cgg gcc agc	336
Ser Ile Asn Glu Leu Gly Ile Ala Leu Ala Ala Gly Phe Pro Ala Ser	
100 105 110	
cgt atc acc gcg cac ggc aac aac aaa ggc gta gag ttc ctg cgc gcg	384
Arg Ile Thr Ala His Gly Asn Asn Lys Gly Val Glu Phe Leu Arg Ala	
115 120 125	
ttg gtt caa aac ggt gtc ggg cat gtg gtg ctg gac tcc gcg cag gaa	432
Leu Val Gln Asn Gly Val Gly His Val Val Leu Asp Ser Ala Gln Glu	
130 135 140	
ttg gaa ctg ctg gat tac gtt gcc gct ggt gaa ggc aag atc cag gac	480
Leu Val Glu Leu Leu Asp Tyr Val Ala Ala Gly Glu Gly Lys Ile Gln Asp	
145 150 155 160	
gtg ttg atc cgc gtg aag cca ggt atc gaa gcc cac acc cac gag ttc	528
Val Leu Ile Arg Val Lys Pro Gly Ile Ala His Thr His Glu Phe	
165 170 175	
atc gcc act agc cac gaa gac cag aag ttc gga ttc tcc ctg gca tcc	576
Ile Ala Thr Ser His Glu Asp Gln Lys Phe Gly Phe Ser Leu Ala Ser	
180 185 190	
ggg tcc gca ttc gaa gca gcg aaa gca gcc aac aat gca gag aac ttg	624
Gly Ser Ala Phe Glu Ala Ala Lys Ala Ala Asn Asn Ala Glu Asn Leu	
195 200 205	
aac ctg gtt ggt ctg cac tgc cat gtt ggt tcc cag gtg ttc gac gcc	672
Asn Leu Val Gly Leu His Cys His Val Gly Ser Gln Val Phe Asp Ala	
210 215 220	
gaa ggc ttc aag ctg gca gca gag gcg gtg ttg ggc ctg tac tca cag	720
Glu Gly Phe Lys Leu Ala Ala Glu Arg Val Leu Gly Leu Tyr Ser Gln	
225 230 235 240	
atc cac agc gaa cta ggt gtc gcc ctt cct gag ctg gac ctc ggt ggc	768
Ile His Ser Glu Leu Gly Val Ala Leu Pro Glu Leu Asp Leu Gly Gly	
245 250 255	
gga tac ggc atc gcc tac act gca gat gag gaa cca ctc aac gtc gca	816
Gly Tyr Gly Ile Ala Tyr Thr Ala Asp Glu Glu Pro Leu Asn Val Ala	
260 265 270	
gaa gtc gcc tcc gac ct	833
Glu Val Ala Ser Asp Leu	
275	

<210> 21

<211> 278

<212> PRT

<213> Corynebacterium glutamicum

<400> 21

Met Ala Thr Val Glu Asn Phe Asn Glu Leu Pro Ala His Val Trp Pro
1 5 10 15

Arg Asn Ala Val Arg Gln Glu Asp Gly Val Val Thr Val Ala Gly Val
 20 25 30

Pro Leu Pro Asp Leu Ala Glu Glu Tyr Gly Thr Pro Leu Phe Val Val
 35 40 45

Asp Glu Asp Asp Phe Arg Ser Arg Cys Arg Asp Met Ala Thr Ala Phe
 50 55 60

Gly Gly Pro Gly Asn Val His Tyr Ala Ser Lys Ala Phe Leu Thr Lys
 65 70 75 80

Thr Ile Ala Arg Trp Val Asp Glu Glu Gly Leu Ala Leu Asp Ile Ala
 85 90 95

Ser Ile Asn Glu Leu Gly Ile Ala Leu Ala Ala Gly Phe Pro Ala Ser
 100 105 110

Arg Ile Thr Ala His Gly Asn Asn Lys Gly Val Glu Phe Leu Arg Ala
 115 120 125

Leu Val Gln Asn Gly Val Gly His Val Val Leu Asp Ser Ala Gln Glu
 130 135 140

Leu Glu Leu Leu Asp Tyr Val Ala Ala Gly Glu Gly Lys Ile Gln Asp
 145 150 155 160

Val Leu Ile Arg Val Lys Pro Gly Ile Glu Ala His Thr His Glu Phe
 165 170 175

Ile Ala Thr Ser His Glu Asp Gln Lys Phe Gly Phe Ser Leu Ala Ser
 180 185 190

Gly Ser Ala Phe Glu Ala Ala Lys Ala Ala Asn Asn Ala Glu Asn Leu
 195 200 205

Asn Leu Val Gly Leu His Cys His Val Gly Ser Gln Val Phe Asp Ala
 210 215 220

Glu Gly Phe Lys Leu Ala Ala Glu Arg Val Leu Gly Leu Tyr Ser Gln
 225 230 235 240

Ile His Ser Glu Leu Gly Val Ala Leu Pro Glu Leu Asp Leu Gly Gly
 245 250 255

Gly Tyr Gly Ile Ala Tyr Thr Ala Asp Glu Glu Pro Leu Asn Val Ala
 260 265 270

Glu Val Ala Ser Asp Leu
275

<210> 22

<211> 28

<212> DNA

<213> Artificial

<220>

<223> Primer

<400> 22
gggtacctcg cgaagtagca cctgtcac

28

<210> 23

<211> 26

<212> DNA

<213> Artificial

<220>

<223> Primer

<400> 23
gcggatcccc catcgcccct caaaga

26

<210> 24

<211> 21

<212> DNA

<213> Artificial

<220>

<223> Primer

<400> 24
aacgggcggt gaagggcaac t

21

<210> 25

<211> 21

<212> DNA
 <213> Artificial

 <220>
 <223> Primer
 <400> 25
 tgaaagacag gggatatccag a 21

 <210> 26
 <211> 24
 <212> DNA
 <213> Artificial

 <220>
 <223> Primer
 <400> 26
 ccatggtacc aagtgcgtgg cgag 24

 <210> 27
 <211> 25
 <212> DNA
 <213> Artificial

 <220>
 <223> Primer
 <400> 27
 ccatggtacc acactgtttc cttgc 25

 <210> 28
 <211> 36
 <212> DNA
 <213> Artificial

 <220>
 <223> Primer

<400> 28
ctggttccgg cgagtgaggc cgaccattcc gcgagg 36

<210> 29

<211> 36

<212> DNA

<213> Artificial

<220>

<223> Primer

<400> 29
ctcgctccgg cgaggtcgga ggcaacttct gcgacg 36

<210> 30

<211> 6

<212> DNA

<213> Artificial

<220>

<223> Primer

<400> 30
ggtacc 6

<210> 31

<211> 18

<212> DNA

<213> Artificial

<220>

<223> Primer

<400> 31
ggatcttcac ctatgatcc 18

<210> 32

<211> 16

<212> DNA

<213> Artificial

<220>

<223> Primer

<400> 32
ccctgataaa tgcttc

16

<210> 33

<211> 25

<212> DNA

<213> Artificial

<220>

<223> Primer

<400> 33
ccggagaaga tgtaacaatg gctac

25

<210> 34

<211> 25

<212> DNA

<213> Artificial

<220>

<223> Primer

<400> 34
cctcgactgc agaccctag acacc

25

<210> 35

<211> 421

<212> PRT

<213> Corynebacterium glutamicum

<400> 35

Met Ala Leu Val Val Gln Lys Tyr Gly Gly Ser Ser Leu Glu Ser Ala
1 5 10 15

Glu Arg Ile Arg Asn Val Ala Glu Arg Ile Val Ala Thr Lys Lys Ala
 20 25 30
 Gly Asn Asp Val Val Val Val Val Ser Ala Met Gly Asp Thr Thr Asp
 35 40 45
 Glu Leu Leu Glu Leu Ala Ala Ala Val Asn Pro Val Pro Pro Ala Arg
 50 55 60
 Glu Met Asp Met Leu Leu Thr Ala Gly Glu Arg Ile Ser Asn Ala Leu
 65 70 75 80
 Val Ala Met Ala Ile Glu Ser Leu Gly Ala Glu Ala Gln Ser Phe Thr
 85 90 95
 Gly Ser Gln Ala Gly Val Leu Thr Thr Glu Arg His Gly Asn Ala Arg
 100 105 110
 Ile Val Asp Val Thr Pro Gly Arg Val Arg Glu Ala Leu Asp Glu Gly
 115 120 125
 Lys Ile Cys Ile Val Ala Gly Phe Gln Gly Val Asn Lys Glu Thr Arg
 130 135 140
 Asp Val Thr Thr Leu Gly Arg Gly Gly Ser Asp Thr Thr Ala Val Ala
 145 150 155 160
 Leu Ala Ala Ala Leu Asn Ala Asp Val Cys Glu Ile Tyr Ser Asp Val
 165 170 175
 Asp Gly Val Tyr Thr Ala Asp Pro Arg Ile Val Pro Asn Ala Gln Lys
 180 185 190
 Leu Glu Lys Leu Ser Phe Glu Glu Met Leu Glu Leu Ala Ala Val Gly
 195 200 205
 Ser Lys Ile Leu Val Leu Arg Ser Val Glu Tyr Ala Arg Ala Phe Asn
 210 215 220
 Val Pro Leu Arg Val Arg Ser Ser Tyr Ser Asn Asp Pro Gly Thr Leu
 225 230 235 240
 Ile Ala Gly Ser Met Glu Asp Ile Pro Val Glu Glu Ala Val Leu Thr
 245 250 255
 Gly Val Ala Thr Asp Lys Ser Glu Ala Lys Val Thr Val Leu Gly Ile
 260 265 270

Ser Asp Lys Pro Gly Glu Ala Ala Lys Val Phe Arg Ala Leu Ala Asp
 275 280 285

Ala Glu Ile Asn Ile Asp Met Val Leu Gln Asn Val Ser Ser Val Glu
 290 295 300

Asp Gly Thr Thr Asp Ile Thr Phe Thr Cys Pro Arg Ser Asp Gly Arg
 305 310 315 320

Arg Ala Met Glu Ile Leu Lys Lys Leu Gln Val Gln Gly Asn Trp Thr
 325 330 335

Asn Val Leu Tyr Asp Asp Gln Val Gly Lys Val Ser Leu Val Gly Ala
 340 345 350

Gly Met Lys Ser His Pro Gly Val Thr Ala Glu Phe Met Glu Ala Leu
 355 360 365

Arg Asp Val Asn Val Asn Ile Glu Leu Ile Ser Thr Ser Glu Ile Arg
 370 375 380

Ile Ser Val Leu Ile Arg Glu Asp Asp Leu Asp Ala Ala Arg Ala
 385 390 395 400

Leu His Glu Gln Phe Gln Leu Gly Gly Glu Asp Glu Ala Val Val Tyr
 405 410 415

Ala Gly Thr Gly Arg
 420

<210> 36

<211> 421

<212> PRT

<213> Corynebacterium glutamicum

<400> 36

Met Ala Leu Val Val Gln Lys Tyr Gly Gly Ser Ser Leu Glu Ser Ala
 1 5 10 15

Glu Arg Ile Arg Asn Val Ala Glu Arg Ile Val Ala Thr Lys Lys Ala
 20 25 30

Gly Asn Asp Val Val Val Val Cys Ser Ala Met Gly Asp Thr Thr Asp
 35 40 45

Glu Leu Leu Glu Leu Ala Ala Ala Val Asn Pro Val Pro Pro Ala Arg
 50 55 60

Glu Met Asp Met Leu Leu Thr Ala Gly Glu Arg Ile Ser Asn Ala Leu
 65 70 75 80

Val Ala Met Ala Ile Glu Ser Leu Gly Ala Glu Ala Gln Ser Phe Thr
 85 90 95

Gly Ser Gln Ala Gly Val Leu Thr Thr Glu Arg His Gly Asn Ala Arg
 100 105 110

Ile Val Asp Val Thr Pro Gly Arg Val Arg Glu Ala Leu Asp Glu Gly
 115 120 125

Lys Ile Cys Ile Val Ala Gly Phe Gln Gly Val Asn Lys Glu Thr Arg
 130 135 140

Asp Val Thr Thr Leu Gly Arg Gly Gly Ser Asp Thr Thr Ala Val Ala
 145 150 155 160

Leu Ala Ala Ala Leu Asn Ala Asp Val Cys Glu Ile Tyr Ser Asp Val
 165 170 175

Asp Gly Val Tyr Thr Ala Asp Pro Arg Ile Val Pro Asn Ala Gln Lys
 180 185 190

Leu Glu Lys Leu Ser Phe Glu Glu Met Leu Glu Leu Ala Ala Val Gly
 195 200 205

Ser Lys Ile Leu Val Leu Arg Ser Val Glu Tyr Ala Arg Ala Phe Asn
 210 215 220

Val Pro Leu Arg Val Arg Ser Ser Tyr Ser Asn Asp Pro Gly Thr Leu
 225 230 235 240

Ile Ala Gly Ser Met Glu Asp Ile Pro Val Glu Glu Ala Val Leu Thr
 245 250 255

Gly Val Ala Thr Asp Lys Ser Glu Ala Lys Val Thr Val Leu Gly Ile
 260 265 270

Ser Asp Lys Pro Gly Glu Ala Ala Lys Val Phe Arg Ala Leu Ala Asp
 275 280 285

Ala Glu Ile Asn Ile Asp Met Val Leu Gln Asn Val Ser Ser Val Glu
 290 295 300

Asp Gly Thr Thr Asp Ile Thr Phe Thr Cys Pro Arg Ala Asp Gly Arg
305 310 315 320

Arg Ala Met Glu Ile Leu Lys Lys Leu Gln Val Gln Gly Asn Trp Thr
325 330 335

Asn Val Leu Tyr Asp Asp Gln Val Asp Lys Val Ser Leu Val Gly Ala
340 345 350

Gly Met Lys Ser His Pro Gly Val Thr Ala Glu Phe Met Glu Ala Leu
355 360 365

Arg Asp Val Asn Val Asn Ile Glu Leu Ile Ser Thr Ser Glu Ile Arg
370 375 380

Ile Ser Val Leu Ile Arg Glu Asp Asp Leu Asp Ala Ala Ala Arg Ala
385 390 395 400

Leu His Glu Gln Phe Gln Leu Gly Gly Glu Asp Glu Ala Val Val Tyr
405 410 415

Ala Gly Thr Gly Arg
420

<210> 37

<211> 421

<212> PRT

<213> Corynebacterium glutamicum

<400> 37

Met Ala Leu Val Val Gln Lys Tyr Gly Gly Ser Ser Leu Glu Ser Ala
1 5 10 15

Glu Arg Ile Arg Asn Val Ala Glu Arg Ile Val Ala Thr Lys Ala
20 25 30

Gly Asn Asp Val Val Val Val Cys Ser Ala Met Gly Asp Thr Thr Asp
35 40 45

Glu Leu Leu Glu Leu Ala Ala Ala Val Asn Pro Val Pro Pro Ala Arg
50 55 60

Glu Met Asp Met Leu Leu Thr Ala Gly Glu Arg Ile Ser Asn Ala Leu
65 70 75 80

Val Ala Met Ala Ile Glu Ser Leu Gly Ala Glu Ala Gln Ser Phe Thr
 85 90 95

Gly Ser Gln Ala Gly Val Leu Thr Thr Glu Arg His Gly Asn Ala Arg
 100 105 110

Ile Val Asp Val Thr Pro Gly Arg Val Arg Glu Ala Leu Asp Glu Gly
 115 120 125

Lys Ile Cys Ile Val Ala Gly Phe Gln Gly Val Asn Lys Glu Thr Arg
 130 135 140

Asp Val Thr Thr Leu Gly Arg Gly Gly Ser Asp Thr Thr Ala Val Ala
 145 150 155 160

Leu Ala Ala Ala Leu Asn Ala Asp Val Cys Glu Ile Tyr Ser Asp Val
 165 170 175

Asp Gly Val Tyr Thr Ala Asp Pro Arg Ile Val Pro Asn Ala Gln Lys
 180 185 190

Leu Glu Lys Leu Ser Phe Glu Glu Met Leu Glu Leu Ala Ala Val Gly
 195 200 205

Ser Lys Ile Leu Val Leu Arg Ser Val Glu Tyr Ala Arg Ala Phe Asn
 210 215 220

Val Pro Leu Arg Val Arg Ser Ser Tyr Ser Asn Asp Pro Gly Thr Leu
 225 230 235 240

Ile Ala Gly Ser Met Glu Asp Ile Pro Val Glu Glu Ala Val Leu Thr
 245 250 255

Gly Val Ala Thr Asp Lys Ser Glu Ala Lys Val Thr Val Leu Gly Ile
 260 265 270

Ser Asp Lys Pro Gly Glu Ala Ala Lys Val Phe Arg Ala Leu Ala Asp
 275 280 285

Ala Glu Ile Asn Ile Asp Met Val Leu Gln Asn Val Ser Ser Val Glu
 290 295 300

Asp Gly Thr Thr Asp Ile Thr Phe Thr Cys Pro Arg Ala Asp Gly Arg
 305 310 315 320

Arg Ala Met Glu Ile Leu Lys Lys Leu Gln Val Gln Gly Asn Trp Thr
 325 330 335

Asn Val Leu Tyr Asp Asp Gln Val Gly Lys Val Ser Leu Val Gly Ala
340 345 350

Gly Met Lys Ser His Pro Gly Val Thr Ala Glu Phe Met Glu Ala Leu
355 360 365

Arg Asp Val Asn Val Asn Ile Glu Leu Ile Ser Thr Ser Glu Ile Arg
370 375 380

Ile Ser Val Leu Ile Arg Glu Asp Asp Leu Asp Ala Ala Ala Arg Ala
385 390 395 400

Leu His Glu Gln Phe Gln Leu Gly Gly Glu Asp Glu Ala Val Val Tyr
405 410 415

Ala Gly Thr Gly Arg
420